

## **SECTION 38: CATHODIC PROTECTION**

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**38-01 SCOPE.** The Work shall consist of furnishing and installing the cathodic protection in accordance with the Plans and these Standard Provisions.

**38-02 GENERAL.** All materials shall conform to the requirements set forth herein as shown on the Standard Details, unless otherwise specified. All materials must be new, free from defects and shall be the best commercial quality for the purpose specified. All necessary items and accessories not shown on the Standard Details or specified herein but which are required to fully carry out the specified intent of the Work, shall be furnished by the Contractor without additional cost to the owner.

### **38-03 REFERENCE SPECIFICATIONS.**

1. American Society for Testing and Materials (ASTM).
2. National Electrical Manufacturers Association (NEMA).
3. Underwriters Laboratory (UL).

### **38-04 SUBMITTALS.**

**38-04.01 Product Data.** Submittals shall include catalog cuts, product data sheets or shop drawings to clearly define to demonstrate full compliance with the Plans and this section of the Standard Provisions.

### **38-05 MATERIALS.**

**38-05.01 Galvanic Anodes.** Zinc anodes shall be sized as shown on the Standard Details. Each anode shall be cast with a steel core, and the core shall protrude from one end and shall be of sufficient length to permit attachment of a lead wire. Each anode shall conform to the chemical composition as required by ASTM B418-73, Type I.

Magnesium anodes shall be sized as shown on the Standard Details. Each anode shall be cast with a steel core, and the core shall protrude from one end with sufficient length to permit attachment of an anode cable. Each anode shall conform to the following chemical composition:

Aluminum	0.01% maximum
Manganese	0.50% to 1.3%
Iron	0.03% maximum

Nickel	0.001% maximum
Copper	0.02% maximum
Total impurities	0.30%
Other impurities	0.05%
Magnesium	Balance

Each anode shall be furnished with a lead wire attached to one end of the steel core, and the wire shall be of sufficient unspliced length to attach the terminal in the terminal box as shown on the Standard Details. The wire shall be connected to the steel core by silver soldering and the connections shall be mechanically secure by soldering with at least two (2) turns of wire to the steel core. The entire connection shall be insulated with an electrical potting compound. The cable attached to the anode shall be No. 10 AWG, Type THW, stranded, single conductor, and shall conform to Federal Specification J-C-30.

The anode shall be packaged in a permeable cloth bag filled with a mixture of seventy-five percent (75%) ground hydrated gypsum, twenty percent (20%) powdered bentonite and five percent (5%) anhydrous sodium sulfate. Backfill grain size shall pass one hundred percent (100%) through a one hundred (100) mesh sieve. The mixture shall be firmly packed around the anode within the cloth bag by vibrations so that the zinc ingot is completely surrounded with a minimum one inch (1") of backfill material.

**38-05.02 Cables.** All underground cables used for the cathodic protection testing and binding cable shall be sized as shown on the Standard Details and shall be stranded, single conductor, copper, Type CP, and shall be insulated with an extruded plastic insulation. The cable shall be insulated for six hundred (600) volts, high molecular weight polyethylene, 110-mil. minimum thickness, in accordance with the requirements of ASTM D-1248, Type 1, Class C, Grade 5 and ICEA-NEMA S-61-402.

**38-05.03 Rigid PVC Conduit and Fittings.** Rigid polyvinylchloride (PVC) conduit and fittings shall be Schedule 80, manufactured to NEMA TC-2 and WC-1094 specifications and shall be UL approved.

**38-05.04 Insulating Flexible Couplings.** Insulating-type flexible couplings shall comply with all requirements for fittings furnished for the pipeline and shall be provided with synthetic rubber boots (sleeves) which electrically isolate the ends of the attached pipe from the fitting as shown on the Standard Details. The couplings shall be epoxy-coated in accordance with Section 33-02.18, "Epoxy Coatings."

**38-05.05 Flexible Couplings (Noninsulating).** All noninsulating flexible couplings shall be bonded as shown on the Standard Details and shall be epoxy-coated in accordance with Section 33-02.18, "Epoxy Coatings."

**38-05.06 Ducseal Putty.** Putty used for cable to pipe connection seal around welder shall be manufactured by Duco Company or an approved equal.

**38-05.07 Polyethylene Tape.** Polyethylene tape shall be 12-mil. thick adhesive backed No. 930-12 Polyken applied over a Polyken 927 primer.

**38-05.08 Exothermic Welds.** All cable connections to pipe, or fittings, shall be accomplished by using a "Cadweld" by Erico Products, Inc., or an approved equal. Each cable shall be fitted with a copper sleeve at the weld. Cartridge (weld metal) sleeves and molds for each weld shall be furnished by the same manufacturer. Weld material used for welds of ductile iron or malleable iron shall be used as required by the manufacturer for cast iron.

**38-05.09 Terminal Boxes.** Terminal boxes shall be constructed of high impact, molded, Lexan plastic, and furnished with a PVC conduit as shown. Each box shall be furnished with an integral high impact Lexan terminal board with a sufficient number of terminals for each cable. All boxes shall be blue color for easy identification.

**38-05.10 Terminal Hardware.** Nuts, bolts and washers shall be nickel-plated brass, and bonded straps shall be nickel-plated copper.

**38-05.11 Shunts.** Anode metering shunts shall be 0.01 ohm rated for six (6) amperes with two percent (2%) accuracy. Shunts furnished for the service installations shall be a manganin wire, Type RS, Holloway or approved equal.

**38-05.12 Ground Clamps.** Ground clamps shall be all brass with a brass set screw.

**38-05.13 Valve Boxes.** Valve boxes shall be in accordance with Paragraph 33-02.07, "Gate Valve Boxes," of these Standard Provisions. The cover shall be manufactured with "CTS" cast in two-inch (2") high letter markings for easy identification.

**38-05.14 Insulating Flange Joints.** Each insulating flange set shall consist of a full-face central gasket, a full-length sleeve for each flange bolt, and two (2) insulating washers with two (2) steel washers for each bolt. The ring-type central gasket shall be one-eighth inch (1/8") thick sheet packing, having a high dielectric constant. Bolt sleeves and insulating washers shall be constructed of fabric-reinforced phenolic resin. The complete assembly shall have an ANSI pressure rating equal to that of the flanges between which is installed.

**38-05.15 Meter Couplings.** Meter couplings (tailpieces) at the service meter shall be Mueller H-10871 or an approved equal.

**38-05.16 Epoxy Putty.** Putty used for the cable to pipe connection seal dam shall be "A + B" epoxy No. 9901 as manufactured by Hexcel Company or an approved equal.

**38-05.17 Epoxy.** Epoxy used for sealing anode to cable and cable to pipe connections shall be Concrevice No. 1011, as manufactured by Adhesive Engineering; Scotchcast Resin No. 4, as manufactured by 3M Company, or CC-1 Potting Compound, manufactured by PSI Products; or an approved equal.

**38-05.18 Bitumastic.** Bitumastic for coating couplings and insulated flange joints shall conform to the requirements of Bureau of Reclamation Specification CA-50.

### **38-06 INSTALLATION OF CATHODIC PROTECTION.**

**38-06.01 General.** All workmanship, installation and materials shall conform with all requirements of the legally constituted authority having jurisdiction. These authorities include, but are not limited to, the latest version of the State of California, Department of Industrial Relations, Division of Industrial Safety, Electrical Order; the National Electric Code, General Construction Safety Orders of the Industrial Accident Commission; and all other applicable State, County or City codes and regulations. Nothing in the Standard Provisions is to be construed to promote work not conforming to these regulations and codes. Larger size or better grade materials shall be installed as required by these regulations and codes.

**38-06.02 Storage of Materials.** All equipment and materials to be used in construction shall be stored in such a manner to protect from detrimental effects from the elements. Damaged or defective equipment and materials shall not be used or stored on the site.

**38-06.03 Cables.** Cables buried in the ground shall be laid straight, without kinks and shall have a minimum cover of thirty inches (30"). Each cable run shall be free of joints or splices and continuous in length. Care shall be used during installation to avoid cuts, punctures or similar damage to insulation. Any damage to insulation will require replacement of the entire cable length. Pull boxes and splice boxes shall be installed where shown and where otherwise required to facilitate installation of conductors and to comply with code requirements. Backfill surrounding the cable shall be native soil free of rocks, gravel and foreign material.

**38-06.04 Galvanic Anodes.** Galvanic anodes shall be installed in an eight-inch (8") diameter hole drilled to the proper depth or placing a horizontal trench at the proper depth. Prior to placing anodes, paper or plastic bags shall be removed, but the cloth bag shall remain around the anode. Care shall be exercised during installation to prevent damage to the cloth bag and loss of backfill material. After placing anodes,

native soil, free of rocks and other foreign objects, shall be placed around the anode and to a minimum of six inches (6") above the anode. Backfill shall then be flooded with water. Remainder of the hole/trench shall be backfilled with native soil in unimproved areas and select native backfill or import material to pavement subgrade. During installation, anodes shall not be supported or handled by the use of attached wires. Backfill and compaction shall be equal to or greater than ninety percent (90%) relative density.

**38-06.05 Joint Bonding.** All pipe and fitting joints shall be bonded for electrical continuity in accordance with details shown on the Standard Details except welded or flanged joints not epoxy-coated. The bond cable shall be installed with a cable loop with sufficient length to allow maximum movement of the pipe without producing tensile stress in the cable.

**38-06.06 Bonding Flexible Couplings.** After installation, all noninsulating flexible-type couplings shall be bonded as shown on the Standard Details. The overall length of each conductor shall be sufficiently greater than the distance between weld connections to permit maximum pullout of pipe ends from the coupling without transferring any tensile stress to the cable or welds. Connection of cable to pipe shall be in accordance with the requirements specified herein.

**38-06.07 Cable to Pipe and Coupling Connections.** Cable to pipe and coupling connections shall be installed in the manner and at the location shown on the Standard Details. Coating materials shall be removed from the surface over an area just sufficient to make the connection. The iron and steel surface shall be cleaned to white metal by grinding or filing prior to welding the conductor. Grinding with resin impregnated wheels shall not be allowed. The conductor shall be welded to the pipe by the exothermic process with a copper sleeve fitting over the conductor and only sufficient insulation shall be removed from the conductor to allow placing in the welding mold. After the weld has cooled, all slag shall be removed and the welds shall be tested with a sharp hammer blow to assure proper metallurgical bond. All defective welds shall be removed and replaced. All exposed surfaces of copper and steel shall be covered with a minimum thickness of one-fourth inch (1/4") of insulating materials as shown on the Standard Details.

**38-06.08 Anode Junction Boxes.** Anode junction boxes shall be installed at locations designated from the Standard Details. Exact location of anode junction boxes shall be determined by the Engineer in the field. The color of each cable shall be utilized to identify the cable as shown, test cable shall be red and drain cable shall be white. Anode cables shall be black.

**38-06.09 Insulated Flanged Joints.** All insulating components of the insulating flanged gaskets shall be cleaned of all dirt, oil, grease and all foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the

insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be fifty thousand (50,000) ohms. Where the insulating joint is assembled in the shop and shipped as a unit, resistance shall be measured in the shop between the flanges in between each bolt and flange, and shall meet the above requirements. After installation, all flanges buried, submerged or located in the ground level boxes, shall have a bitumastic coating applied to all bare metal such as bolt threads and chipped paint and shall be completely encased in a polyethylene wrap.

**38-06.10 Coating Mechanical Couplings.** All buried mechanical couplings shall epoxy coated in accordance with Paragraph 33-02.18 entitled, "Epoxy Coatings." Pipe and coupling components shall be cleaned of dirt and foreign materials prior to placement of the coating. After installation of the fitting, a bitumastic coating shall be applied to all bare metal such as bolt threads and chipped paint and shall be completed encased in a polyethylene wrap.

**38-06.11 Energizing and Testing.** The Contractor shall be responsible for all cathodic protection testing by a corrosion specialist certified by the National Association of Corrosion Engineers (NACE) or a corrosion engineer licensed in the State of California. No connection shall be allowed between the pipe and the anode prior to testing so the Contractor or Contractor's testing firm can get true native soil potentials. The Contractor or Contractor's testing firm will make the final connections. The Contractor shall mark the wires and submit a drawing that identifies the wires prior to testing. All testing will be done in the presence of the engineer.

The cathodic protection system, including all anode, joint bonds and insulation flanged joints shall be tested prior to paving and upon completion of tests, a detailed report shall be submitted to the City describing any deficiencies detected. Criteria for acceptance of cathodic protection system are defined in the National Association of Corrosion Engineering Publication RP-01-69. Any deficiencies shall be corrected by the contractor at no additional cost. Final testing of the system shall be done after final paving and all deficiencies shall be corrected by the Contractor prior to final acceptance and a detailed report shall be submitted to the City's Engineer.

**38-06.12 Cleanup.** The Contractor shall be responsible for cleanup and removal of all debris, extra material and equipment utilized for installation of the cathodic protection system.

### **38-07 BASIS OF PAYMENT.**

**38-07.01 Payment Basis.** The lump sum contract price for this item of Work shall constitute full compensation for all Work and materials required to complete the installation and testing of the cathodic protection as required in the Special Provisions and shown on the Plans and specified herein.

**38-07.02 Measurement for Payment.** Measurement for payment shall be a lump sum basis and shall include all Work specified in these Standard Provisions and not included in other items of Work.